The Cryosphere Discussions

The Cryosphere Discuss., referee comment RC2
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Comment on tc-2021-297

Anonymous Referee #2

Referee comment on "A database of daily Lagrangian Arctic sea ice parcel drift tracks with coincident ice and atmospheric conditions to study the fate of sea ice in the 'New Arctic'" by Sean Horvath et al., The Cryosphere Discuss., https://doi.org/10.5194/tc-2021-297-RC2, 2021

Summary

This paper documents the assembly of a database of lagrangian drift tracks that includes many of the variables needed to study changes in the surface energy budget (SEB).

They assert that the database can be used to study a range of SEB processes, and present some results from the assembled dataset. However, the authors also show that the drift tracks have mean errors of 82.6 km, and can be as high as 500 km in certain areas, so the "tracks" are probably not actually following the same parcel of sea ice.

Detailed Major Suggestions and Comments:

- The paper needs a good scientific hypothesis or question to guide the research.
  - This paper jumps into the middle of the scientific process by first producing a database, then trying to find questions that the database may help answer. A more fruitful approach would be to find a scientific hypothesis, then assemble data to test that hypothesis.
- Mean errors of 82.6 km for the lagrangian tracks may or may not be large depending on the scientific question a person is trying to answer.
  - 2.1 For example, if one were trying to understand the roll of large scale cyclones, then this probably is not an issue, but if one were trying to understand the small scale changes in ice concentration, then this error is unacceptable. Looking at Figure

1, the authors mark a 25km x 25 km box. A shift of even just a few km, shows that we are looking at an area of much higher sea ice concentration than the sea ice parcel that is highlighted. The SEB in the marked pixel is much different that the SEB in the parcels surrounding this.
    - 2.2 If the mean errors are this large in reproducing the tracks of a buoy that is included in the gridded ice motion database, how much larger are the errors in areas without buoys?
    - 2.3 Given the errors in reproducing lagrangian tracks, why not just use the actual drift tracks of the buoys? For example, the Ice Mass Balance buoys measure many of the quantities assembled here.
    - 2.4 Section 3.2.2, and Figure 5: Are the differences seen in each of the panels due to real physical changes in the parcel compared to the buoy observations, or due to errors in the lagrangian tracks?
- All the different datasets assembled here also have their own errors. As with comment 2 above, whether these errors are acceptable depends on the scientific questions we are trying to answer.
    - 3.1 One thing to note is that a "lagrangian approach" may also be taken by directly using many of the disparate datasets they assembled here. For example, PIOMAS includes many of these variables as forcing or as estimates from the model. PIOMAS is well documented so the errors, biases and uncertainties are known. The model can give us a "self consistent" framework to do lagrangian studies by tracking a parcel using the ice motion provided by the model.
    - 3.2 By assembling disparate datasets as is done here, we lose the "self consistency" of each data set and quantifying the errors in our results becomes difficult. Following example, looking at figure 9, the sea ice thickness obtained from PIOMAS starts declining in May long before the onset of melt derived from AIRS skin temperatures. How can we explain this given the variables assembled?
    - 3.3 Sea ice thickness also increases in PIOMAS just before the onset of melt in June (Fig. 9). What forces this change? Or is there simply a shift in the pixels that they are tracking?
    - 3.4 A more thorough discussion of errors for each dataset should be included in section 2.
- Reading through their abstract and conclusions, the primary contributions of this paper to science are: 1) they produced a lagrangian data base, and 2), they find an increase in the number of sea ice parcels over time. Both these findings are moot given that they may not be tracking the same parcel of sea ice, and since they note that their lagrangian drift tracks are significantly slower near Fram Strait where most parcels of sea ice is exported from the Arctic. The increase in sea ice parcels over time can probably be attributed to more of their parcels "surviving" since less are exported through Fram Strait compared to the real world.

Minor suggestions and comments:

- Line 35: Change "known as" to "attributed to".
- Figure 5: Add units to each row of plots.
- Figure 7a: separate FYI and MYI bars so that we may be able to see any differences or trends from year to year. Interspersing FYI and MYI as shown makes it hard to see

things.

- Figure 9: Mark cyclones as in Fig. 10. It would be interesting to see if cyclones are related to the changes in in snow depth, or sea ice thickness shown here.